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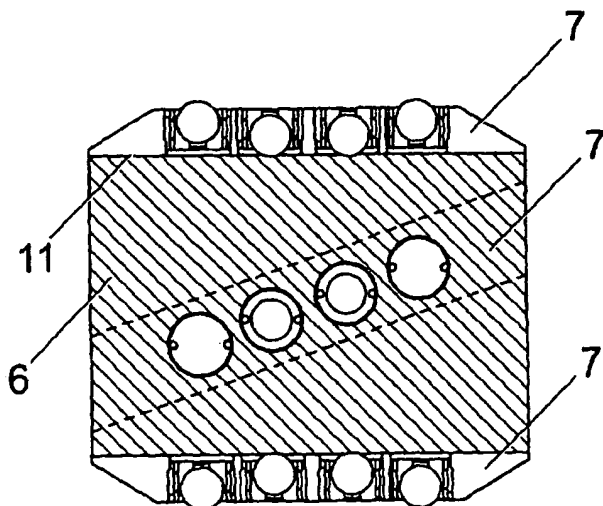


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- (71) Applicant (*for all designated States except US*): **DOWN-HOLE PRODUCTS PLC** [GB/GB]; Badentoy Road, Badentoy Park, Portlethen, Aberdeen AB12 4YA (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (*for US only*): **KIRK, Ian**, Alastair [GB/GB]; 131 North Deeside Road, Milltimber, Aberdeen AB13 0JF (GB). **BARRON, William** [GB/GB]; 61 Seafield Road, Aberdeen AB15 7YU (GB). **CLARK, Alistair, Bertram** [GB/GB]; 7 Westwood Grove, Westhill, Aberdeen AB32 6XF (GB).
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- (74) Agent: **MURGITROYD & COMPANY**; 373 Scotland Street, Glasgow G5 8QA (GB).
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(57) Abstract: A centraliser (1) has a substantially annular body (6), a substantially cylindrical bore extending longitudinally through the body (6), and at least one roller ball (29). The roller ball (29) is preferably secured to the centraliser (1) in a manner which enables the roller ball (29) to rotate in all directions with respect to the centraliser (1), and one roller ball (29) is secured within at least one aperture (9; 109) provided in the sidewall of the body (6). Preferably, an assembly (27, 28, 39; 127, 128, 139) is provided to house the roller ball (29) within the at least one aperture (9; 109), and the roller ball (29) may be arranged to project either outwardly or inwardly from the sidewall.

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1 "Centraliser"

2

3 The present invention relates to a centraliser,
4 typically for use with a casing string, a
5 liner/tubing string or a drill string, which is
6 inserted into a borehole.

7

8 Conventionally, when a well has been drilled for the
9 eventual production of hydrocarbons, one of the
10 procedures commonly employed in readying the well
11 for production comprises installing hollow tubular
12 casing (otherwise known as "a casing string") in the
13 uppermost section of the well to line the borehole.
14 The space (otherwise known as the "annulus") between
15 the exterior of the casing string and inner surface
16 of the borehole is filled with cement which acts as
17 a sealant and provides mechanical support for the
18 casing string. Thereafter, and as is usually
19 required, a smaller diameter tubular string
20 (otherwise known as a "liner string" or "tubing
21 string") is inserted through the casing string in
22 order to line the lower sections of the borehole.

1

2 Since it is desirable that the casing or
3 liner/tubing string be centralised in the wellbore
4 when cemented, it is known to externally mount
5 centralisers on the casing or liner/tubing string to
6 hold the string away from the wellbore; i.e. toward
7 the centre of the borehole.

8

9 However, particularly with very deep and/or extended
10 reach wells, which may be in the region of many
11 thousands of feet in length, it is desirable, and in
12 many cases thought essential, to reduce the friction
13 between the exterior of the centralisers and the
14 inner surface of the borehole, such that the casing
15 or liner/tubing string can more easily be run into
16 the wellbore.

17

18 According to a first aspect of the present
19 invention, there is provided a centraliser
20 comprising a substantially annular body, a
21 substantially cylindrical bore extending
22 longitudinally through the body, the annular body
23 comprising at least one roller ball.

24

25 According to a second aspect of the present
26 invention, there is provided a method of running a
27 string of tubulars into a well bore, the method
28 comprising providing a centraliser comprising a
29 substantially annular body, and a substantially
30 cylindrical bore extending longitudinally through
31 the body, and the annular body comprising at least
32 one roller ball.

1
2 Typically, the centraliser is arranged around a
3 string of tubulars, such that the string of tubulars
4 passes through the substantially cylindrical bore.
5 The string of tubulars may be a casing string, a
6 liner/tubing string or a drill string, and the
7 centraliser is preferably adapted to centralise the
8 string of tubulars within either another string of
9 tubulars such as a casing string or a liner/tubing
10 string or within an open hole.

11
12 Preferably, the roller ball is secured to the
13 centraliser in a manner which enables the roller
14 ball to rotate with respect to the centraliser.

15
16 Typically, the centraliser is provided with at least
17 one aperture, and the roller ball is secured within
18 the aperture, preferably by means of screw threads.
19 The aperture is preferably formed in a sidewall of
20 the centraliser, and more preferably, the aperture
21 is formed in a blade of the centraliser, where the
22 blade typically extends outwardly from the annular
23 body. Typically, a number of blades may be
24 provided.

25
26 The aperture is preferably arranged wholly through
27 the sidewall, and the aperture is preferably
28 arranged such that the roller ball may be arranged
29 to project outwardly from the sidewall and/or may be
30 arranged to project inwardly from the sidewall.
31 Preferably, an assembly is provided to house the
32 roller ball within the aperture, and the aperture is

1 provided with a shoulder which can bear against a
2 portion of the assembly.

3

4 Typically, if the roller ball is arranged to project
5 outwardly from the sidewall, then the shoulder bears
6 against at least a portion of a face of the assembly
7 and if the roller ball is arranged to project
8 inwardly from the sidewall then the shoulder bears
9 against at least a portion of a face of the
10 assembly.

11

12 Typically, if the roller ball is arranged to project
13 outwardly from the sidewall, then the shoulder bears
14 against at least a portion of an inner most face of
15 the assembly and if the roller ball is arranged to
16 project inwardly from the sidewall then the shoulder
17 bears against at least an portion of an inner most
18 face of the assembly.

19

20 Typically, if the roller ball is arranged to project
21 outwardly from the sidewall, then the shoulder bears
22 against at least a portion of a face of the assembly
23 that is farthest away from the projecting surface of
24 the roller ball and if the roller ball is arranged
25 to project inwardly from the sidewall then the
26 shoulder bears against at least an portion of a face
27 of the assembly that is closest to the projecting
28 surface of the roller ball.

29

30 Preferably, a number of apertures may be provided,
31 such apertures typically being spaced apart in the
32 longitudinal direction of the body and which may be

1 circumferentially spaced apart. Typically, the
2 centraliser comprises a plurality of blades.

3

4 Typically, if the roller ball is arranged to project
5 outwardly from the sidewall, it is capable of making
6 contact with the inner surface of a string of
7 tubulars or a bore of an open hole. Typically, if
8 the roller ball is arranged to project inwardly from
9 the sidewall, it is capable of making contact with
10 the string of tubulars passing through the
11 substantially cylindrical bore of the centraliser.

12

13 Preferably, the roller ball is an omnidirectional
14 roller ball.

15

16 The centraliser may be free to rotate with respect
17 to the string of tubulars passing through the
18 substantially cylindrical bore of the centraliser.

19 The centraliser may be free to move along the
20 longitudinal axis of the string of tubulars passing
21 through the substantially cylindrical bore of the
22 centraliser, although the centraliser may be
23 restricted in such axial movement by any suitable
24 means, such as stop collars and the like.

25

26 Alternatively, the centraliser may be locked with
27 respect to the string of tubulars passing through
28 the substantially cylindrical bore of the
29 centraliser by any suitable means such as grub
30 screws and the like.

31

1 According to a third aspect of the present
2 invention, there is provided a roller ball assembly
3 for use with a centraliser, the roller ball assembly
4 comprising a roller ball and a housing for the
5 roller ball, the housing comprising an engagement
6 means capable of engaging with an engagement means
7 of the centraliser.

8
9 Preferably, the roller ball assembly of the third
10 aspect is incorporated in a centraliser of the first
11 and/or second aspects of the invention.

12
13 The housing of the roller ball assembly preferably
14 comprises an inner surface which substantially
15 corresponds to the shape of the roller ball, and an
16 aperture to permit a portion of the roller ball to
17 project outwardly therefrom. Typically, the housing
18 further comprises a seal to prevent ingress of
19 debris from outside of the housing into the interior
20 of the housing, in use. The housing is preferably
21 provided in at least two parts to permit the
22 insertion of the roller ball into the housing, and
23 may be provided with locking means (which are
24 preferably dis-engageable) to prevent movement
25 between the said parts of the housing.

26
27 Typically, the engagement means comprises screw
28 threads. Preferably, the screw threads of the
29 roller ball assembly are provided on an outer
30 surface of the housing.

31

1 A recess or chamber may be provided, typically
2 within the housing, into which a fluid is placed,
3 the fluid providing lubrication between the roller
4 ball and the housing.

5

6 The at least two parts of the housing are preferably
7 secured to one another by applying a compression
8 force thereto.

9

10 The roller ball assembly may be removed from
11 engagement with the centraliser for any desired
12 purpose, such as redressing or refurbishment, or to
13 change the configuration of the roller ball
14 assembly.

15

16 Embodiments of the present invention will now be
17 described, by way of example only, with reference to
18 the accompanying drawings, in which:-

19

20 Fig. 1 is a cross-sectional plan view of a
21 liner/tubing string with a centraliser in
22 accordance with the roller ball assemblies in
23 accordance with the present invention
24 externally mounted thereon, being run into an
25 already cased borehole;

26 Fig. 2 is a cross-sectional side view of the
27 centraliser of Fig. 1 in isolation;

28 Fig. 3 is a plan side view of the centraliser
29 of Fig. 1 in isolation;

30 Fig. 4 is a cross-sectional plan view through
31 an aperture formed in a blade of the
32 centraliser of Fig. 1;

1 Fig. 5 is an exploded side view of a first
2 embodiment of a roller ball assembly for
3 insertion into the aperture of Fig. 4;
4 Fig. 6 is a cross-sectional side view of a
5 blade (having apertures with roller ball
6 assemblies of Fig. 5 mounted therein) of the
7 centraliser of Fig. 1;
8 Fig. 7 is a cross-sectional side view of a
9 blade (having apertures therein) of the
10 centraliser of Fig. 1;
11 Fig. 8 is a cross-sectional side view of a
12 second embodiment of a roller ball assembly
13 within an aperture formed in a blade of the
14 centraliser of Fig. 1;
15 Fig. 9 is a cross-sectional view of the
16 complete roller ball assembly of Fig. 8 in
17 isolation;
18 Fig. 10 is a top plan view of the complete
19 roller ball assembly of Fig. 9;
20 Fig. 11 is an exploded side view of the roller
21 ball assembly of Fig. 9;
22 Fig. 12 is a cross-sectional view of the ball
23 retainer of the roller ball assembly of Fig. 9;
24 Fig. 13 is a cross-sectional view of the ball
25 mount of the roller ball assembly of Fig. 9;
26 and
27 Fig. 14 is a bottom plan view of the ball mount
28 of the roller ball assembly of Fig. 9.
29
30 Fig. 1 shows a centraliser 1 being mounted on the
31 exterior of a liner/tubing string 3, where the
32 liner/tubing string 3 (and hence the centraliser 1)

1 are run into a borehole through an upper section of
2 casing 5 which has already been cemented into the
3 borehole. As is conventionally known, the upper end
4 of the tubing string 3 is run into the borehole
5 until it approximately reaches the lower end of the
6 casing string 5, and at this point the upper end of
7 the tubing string 3 will be hung off on the lower
8 end of the casing string 5. Thereafter, additional
9 cement will conventionally be pumped down the
10 interior of the casing string 5 and hence interior
11 of the tubing string 3 until it settles in the
12 annulus between the exterior of the tubing string 3
13 and the interior of the borehole.

14
15 However, it should be noted that the centraliser 1
16 of the present invention is not limited to such use,
17 and can also be used in running-in casing strings 5
18 and can also mounted on the exterior of drill
19 strings (not shown). Additionally, the centraliser
20 1 can also be used to run in other tubulars (not
21 shown) required downhole, such as screens, for
22 example sand screens, and other tubing.

23
24 As is also conventional, the centraliser 1 can
25 either be rotationally and longitudinally locked to
26 the liner string 3 by any conventional means, such
27 as grub screws (not shown). Alternatively, the
28 centraliser 1 can be preferably be allowed to "free
29 float" along a distinct and predetermined axial
30 length of the tubing string 3 between a pair of stop
31 collars which are mounted on the exterior of the
32 tubing string 3 a set distance apart, such as 10

1 feet for example. The pair of stop collars deny the
2 centraliser 1 the opportunity to travel past either
3 the upper or the lower stop collar.

4

5 The centraliser 1, as shown more clearly in Fig. 2,
6 comprises a generally cylindrical and annular body 6
7 upon which is mounted a plurality of outwardly
8 extending blades 7. In a preferred embodiment,
9 there are four blades 7 provided, but it should be
10 noted that any suitable number of blades 7 could be
11 provided. As also shown in Figs. 2 and 3, each of
12 the blades 7 not only extends between longitudinally
13 opposite ends of the body 6, but also extends
14 circumferentially part-way around the periphery of
15 the body 6 of the centraliser 1. The skewing of the
16 blades 7 amongst other advantages, means that their
17 respective radially outer edges 8 collectively
18 provide a circumferentially substantially uniform
19 wellbore-contacting surface with the centraliser 1.

20

21 The blades 7 are preferably fabricated integrally
22 with the body 6, such that the centraliser 1 is a
23 one-piece article, and may be formed from a suitable
24 metal, alloy or plastic or the like. Alternatively,
25 the blades 7 could be separately formed and
26 subsequently attached to the body 6 by any suitable
27 means, such as welding.

28

29 As shown more clearly on Figs. 4 and 7, each blade 7
30 is provided with a plurality of apertures 9 therein,
31 and in the embodiment shown in the Figs. there are
32 preferably four apertures 9 provided in each blade

1 7. As can be seen in Fig. 4, the central line 10 of
2 each aperture 9 is concentric with the central line
3 10 of the outwardly extending blade 7, and hence the
4 central line 10 of the aperture 9 is parallel with
5 the axis on which the blade 7 outwardly extends.

6
7 The aperture 9 is preferably circular about its
8 central line 10, and comprises an inner portion 12,
9 a middle portion 14 and an outer portion 16. The
10 middle portion 14 is cylindrical in shape, and
11 comprises an axial length (along the central line
12 10) which is the majority of the axial length of the
13 blade 7. The middle portion 14 comprises a screw
14 thread 18 on its inner bore, and which is suitable
15 for engagement with a housing of a roller ball
16 insert 25 (which will be described in more detail
17 subsequently). The junction between the middle
18 portion 14 and the inner portion 12 comprises a
19 shoulder 13 which extends inwardly from the diameter
20 of the middle 14 to the inner 12 portions. The
21 shoulder 13 is typically perpendicular to the
22 central line 10 of the aperture 9. The inner
23 portion 12 extends from the shoulder 13 through to
24 the inner bore 11 of the body 6. Thus, the inner
25 diameter of the inner portion 11 is smaller than the
26 inner diameter of the middle portion 14.

27
28 The outer end of the outer portion 16 is of a
29 greater diameter than the diameter of the inner end
30 of the outer portion 16, such that the outer portion
31 16 has a frusto-conical shape, and this provides the
32 advantage that the roller ball insert 25 (as will be

1 subsequently discussed) can more easily be inserted
2 into the aperture 9 (as will also be subsequently
3 discussed in more detail).

4
5 A first embodiment of a roller ball insert 25 is
6 shown in exploded form in Fig. 5 and comprises a
7 ball retainer 27, a ball seal 28, a ball 29, a ball
8 seat housing 30 and keeper pins 31. The ball
9 retainer 27 comprises a body 35 having a cylindrical
10 outer surface at its lower end and an outwardly
11 extending annular ring 36 provided at its upper end.
12 The lower half of the inner surface of the body 35
13 is substantially cylindrical, and the upper half of
14 the inner surface of the body 35 curves inwardly
15 from the junction with the lower half, such that the
16 upper half of the inner surface of the body 35 has a
17 radius which substantially matches the radius of the
18 ball 29. A cylindrical recess 37 is provided on the
19 inner surface of the upper end of the body 35, and a
20 ball seal 28 is inserted into the recess of 37. A
21 pair of cylindrical bores 38A are drilled through
22 the annular ring 36, such that a semi-circular
23 groove in line with the bores 38A is provided on the
24 outer surface of the body 35. The pair of bores 38A
25 are diametrically opposed to one another.

26
27 The ball seat housing 30 comprises a screwthread 40
28 provided on its outer surface, such that the
29 screwthread 40 is arranged to correspond with the
30 screwthread 18 provided in the aperture 9. A pair
31 of bores 38B are drilled through the housing 30,
32 such that the pair of bores 38B are diametrically

1 opposite one another, and such that the pair of
2 bores 38B are parallel with the longitudinal axis of
3 the housing 30. The housing 30 comprises an upper
4 half 30A and a lower half 30B. The axial extent of
5 the upper half 30A substantially equals the axial
6 extent of the cylindrical outer surface of the body
7 35, such that when the body 35 is inserted into the
8 housing 30, the lower end of the body 35 rests upon
9 shoulder 42 of the housing 30, and the lower face of
10 the annular ring 36 rests upon the upper end of the
11 ball seat housing 30. The lower half 30B has a
12 substantially semi-circular groove 44 formed therein
13 and which has a radius which substantially matches
14 the radius of the ball 29. A rectangular recess 46
15 is provided at the lower end of the semi-circular
16 recess 44, and grease, oil or other friction
17 reducing fluids can be placed into recess 46 such
18 that the ball 29 picks up said friction reducing
19 fluids and is coated therewith.

20

21 The roller ball insert 25 is constructed as follows.
22 The ball 29 is placed into the ball seat 30, such
23 that it rests in the semi-circular recess 44. The
24 ball seal 28 is inserted into the recess 37 of the
25 ball retainer 27, and the ball retainer 27 is
26 pressed into the ball seat housing 30, such that the
27 bores 38A are aligned with the bores 38B. A keeper
28 pin 31 is then inserted by suitable means, such as
29 hammering, into the conjoined bore 38, such that the
30 ball retainer 27 is restrained from rotating with
31 respect to the ball seat housing 30. The ball
32 retainer 27 is compression pressed with great force

1 into the ball seat housing 30 such that a friction
2 fit is provided therebetween, and hence there is
3 minimal risk of the ball retainer 27 from being
4 ejected from the ball seat housing 30. In this
5 manner, the ball 29 is held captive in the roller
6 ball insert 25, but can rotate in all directions
7 with respect thereto.

8
9 Hence, an omnidirectional roller ball insert 25 is
10 provided.

11
12 As shown in Figs. 2, 3 and 6, roller ball inserts 25
13 are screwed into the apertures 9. However, as can
14 also be seen from the Figs., the roller ball inserts
15 25 may be provided in the apertures in two different
16 configurations, these being:-

17
18 a) the roller ball 29 projecting through the ball
19 seal 28 in an outwardly direction from the blades
20 7; and

21
22 b) the roller ball 29 projecting through the ball
23 seal 28 inwardly into the body 6 from the blades
24 7.

25
26 The apertures 9 are arranged such that they can
27 accommodate either configuration a) or b) of the
28 roller ball insert 25. With regard to configuration
29 a), the seat 13 of the aperture 9 provides a stop
30 for the lower (with regard to Fig. 5) face of the
31 ball seat housing 30, and the dimensions of the
32 aperture 9 and the lower roller ball insert 25 are

1 such that the roller ball 29 will project outwardly
2 from the face of the roller ball insert 25, and
3 hence the blades 7.

4

5 With regard to configuration b), the shoulder 13
6 provides a stop for the outer (and upper with regard
7 to Fig. 5) face of the annular ring 36, such that
8 the roller ball 29 projects inwardly into the bore
9 11 of the body 6.

10

11 In use, an operator can choose the configuration of
12 the roller ball inserts 25 between configurations a)
13 and b) as desired. For instance, an operator may
14 wish to have all of the roller ball inserts 25 in a
15 particular centraliser 1 arranged in configuration
16 a). Alternatively, an operator may desire to have
17 all of the roller ball inserts 25 of the centraliser
18 1 arranged in configuration b). Alternatively, an
19 operator may wish to have a combination of
20 configurations a) and b) of the roller ball inserts
21 25 for a particular centraliser 1, and this latter
22 option is shown in Figs. 1, 2, 3 and 6. Further
23 alternatively, an operator may, if desired, wish to
24 blank off one or more apertures with a suitable plug
25 (not shown). The embodiment provides the advantage
26 that roller ball inserts 25 arranged in
27 configuration b) will engage the outer surface of
28 tubing string 3, thus minimising friction between
29 the centraliser 1 and the tubing string 3. In this
30 manner, the tubing string 3 can rotate with respect
31 to the centraliser 1 with minimal friction
32 therebetween.

1
2 A second embodiment of a roller ball insert 125 is
3 shown in exploded form in Fig. 11 and comprises a
4 ball retainer 127, a ball seal 128, a ball 29, and a
5 ball mount or seat housing 130. The ball retainer
6 127 comprises a body 135 having a screwthread 140
7 provided on its outer surface, such that the
8 screwthread 140 is arranged to correspond with the
9 screwthread 118 provided in the aperture 109. The
10 ball retainer 127 comprises an upper half 135A and a
11 lower half 135B. The axial extent of the upper half
12 135A substantially equals the axial extent of the
13 cylindrical outer surface of the ball mount 130,
14 such that when the ball mount 130 is inserted into
15 the ball retainer 127, the upper end of the ball
16 mount 130 rests upon shoulder 142 of the ball
17 retainer 127. The ball mount 130 has a
18 substantially semi-circular groove 144 formed
19 therein and which has a radius which substantially
20 matches the radius of the ball 29. A rectangular
21 recess 146 is provided at the lower end of the semi-
22 circular recess 144, and grease, oil or other
23 friction reducing fluids can be placed into recess
24 146 such that the ball 29 picks up said friction
25 reducing fluids and is coated therewith. In
26 addition, or alternatively, as shown in the Figs., a
27 small aperture 150 is formed on the centre line of
28 the ball mount 130, such that the small aperture 150
29 is aligned, in use, with fluid access aperture 155
30 formed on the centre line of the aperture 109 in the
31 blade 107, such that the ball 29 is lubricated by
32 downhole fluid through the apertures 155 and 150.

1
2 The lower half 135B of the inner surface of the ball
3 retainer 127 is substantially cylindrical, and the
4 upper half 135B of the inner surface of the ball
5 retainer 127 curves inwardly from the junction with
6 the lower half 135B, such that the upper half 135A
7 has a radius which substantially matches the radius
8 of the ball 29. A cylindrical recess 137 is
9 provided on the inner surface of the upper end 135A,
10 and a ball seal 128 is inserted into the recess 137.

11
12 The roller ball insert 125 is constructed as
13 follows. The ball 29 is placed into the ball mount
14 130, such that it rests in the semi-circular recess
15 144. The ball seal 128 is inserted into the recess
16 137 of the ball retainer 127, and the ball mount 130
17 and ball 29 are pressed into the ball retainer. The
18 ball mount 130 is compression pressed with great
19 force into the ball retainer 127 such that a
20 friction fit is provided therebetween, and hence
21 there is minimal risk of the ball mount 130 from
22 being ejected from the ball retainer 127. In this
23 manner, the ball 29 is held captive in the roller
24 ball insert 125, but can rotate in all directions
25 with respect thereto.

26
27 Hence, a second embodiment of omnidirectional roller
28 ball insert 125 is provided.

29
30 It should be noted that the aperture 109 is intended
31 for use with the roller ball insert 125 in the
32 configuration shown in Fig. 8; that is in

1 configuration a) as described above. The reader
2 will understand that the aperture 109 can be
3 modified or formed more akin to the aperture 9 if
4 configuration b) is desired.

5
6 Furthermore, with the roller ball inserts 25
7 arranged in configuration a), the centraliser 1 can
8 rotate with respect to the inner surface of the
9 casing string 5, with minimal friction therebetween.

10
11 However, as previously described, an operator can,
12 if desired, lock the centraliser 1 to the tubing
13 string 3 by any suitable means, such as grub screws,
14 and also can provide a pair of stop collars at a
15 suitable distance apart, and can located a
16 centraliser 1 in between the pair of stop collars,
17 such that the centraliser 1 has a restricted
18 longitudinal and axial travel along the liner tubing
19 string 3, this travel being restricted to the
20 distance that the stop collars are set apart.

21
22 Furthermore, the provision of roller balls 29 in the
23 centraliser 1 provides the advantage over axially
24 arranged rollers that the roller balls 29 are
25 omnidirectional, whereas axial rollers are limited
26 to only acting in one direction.

27
28 The embodiments also have the advantage that the
29 weight acting between the tubing string 3 and the
30 casing string 5 or open hole is spread over a
31 relatively high plurality of roller balls 29.

32

1 The roller ball 29 can be formed from any suitable
2 materials, such as stainless steel, and the roller
3 ball inserts are preferably formed from a suitable
4 material such as an alloy, and which may be brass.

5

6 Modifications and improvements may be made to the
7 embodiment with departing from the scope of the
8 invention.

9

1 CLAIMS:-

2

3 1. A centraliser comprising a substantially
4 annular body, a substantially cylindrical bore
5 extending longitudinally through the body, the
6 annular body comprising at least one roller ball.

7

8 2. A centraliser according to claim 1, wherein the
9 roller ball is secured to the centraliser in a
10 manner which enables the roller ball to rotate in
11 all directions with respect to the centraliser.

12

13 3. A centraliser according to either of claims 1
14 or 2, wherein the centraliser is provided with at
15 least one aperture, and the roller ball is secured
16 within the aperture.

17

18 4. A centraliser according to claim 3, wherein the
19 at least one aperture is formed in a sidewall of the
20 centraliser.

21

22 5. A centraliser according to claim 4, wherein the
23 at least one aperture is formed in a blade of the
24 centraliser.

25

26 6. A centraliser according to any of claims 3 to
27 5, wherein the at least one aperture is arranged
28 wholly through the sidewall.

29

30 7. A centraliser according to any of claims 3 to

1 6, wherein at least one of the apertures is arranged
2 such that the roller ball is arranged to project
3 outwardly from the sidewall.

4

5 8. A centraliser according to any of claims 3 to
6 7, wherein at least one of the apertures is arranged
7 such that the roller ball is arranged to project
8 inwardly from the sidewall.

9

10 9. A centraliser according to any of claims 3 to
11 8, wherein an assembly is provided to house the
12 roller ball within the at least one aperture.

13

14 10. A centraliser according to any of claims 3 to
15 9, wherein the at least one aperture is provided
16 with a shoulder which is adapted, in use, to bear
17 against a portion of the assembly.

18

19 11. A centraliser according to any of claims 3 to
20 10, wherein a plurality of apertures are provided,
21 such apertures being spaced apart in the
22 longitudinal direction of the body.

23

24 12. A method of running a string of tubulars into a
25 well bore, the method comprising providing a
26 centraliser comprising a substantially annular body,
27 and a substantially cylindrical bore extending
28 longitudinally through the body, and the annular
29 body comprising at least one roller ball.

30

31 13. A roller ball assembly for use with a
32 centraliser having an engagement mechanism, the

1 roller ball assembly comprising a roller ball and a
2 housing for the roller ball, the housing comprising
3 an engagement mechanism capable of engagement with
4 the engagement mechanism of the centraliser.
5

6 14. A roller ball assembly according to claim 13,
7 wherein the housing comprises an inner surface which
8 substantially corresponds to the shape of the roller
9 ball, and an aperture to permit a portion of the
10 roller ball to project outwardly therefrom.
11

12 15. A roller ball assembly according to claim 14,
13 wherein the housing further comprises a seal to
14 prevent ingress of debris from outside of the
15 housing into the interior of the housing, in use.
16

17 16. A roller ball assembly according to any of
18 claims claim 13 to 15, wherein the housing is
19 provided in at least two parts to permit the
20 insertion of the roller ball into the housing.
21

22 17. A roller ball assembly according to any of
23 claims 13 to 16, wherein the engagement mechanisms
24 comprise screw threads.
25

26 18. A roller ball assembly according to claim 17,
27 wherein the screw threads of the roller ball
28 assembly are provided on an outer surface of the
29 housing.
30
31

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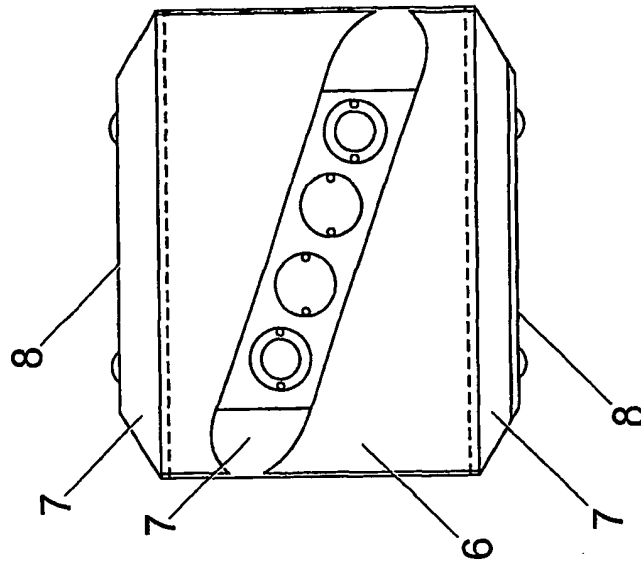


Fig. 3

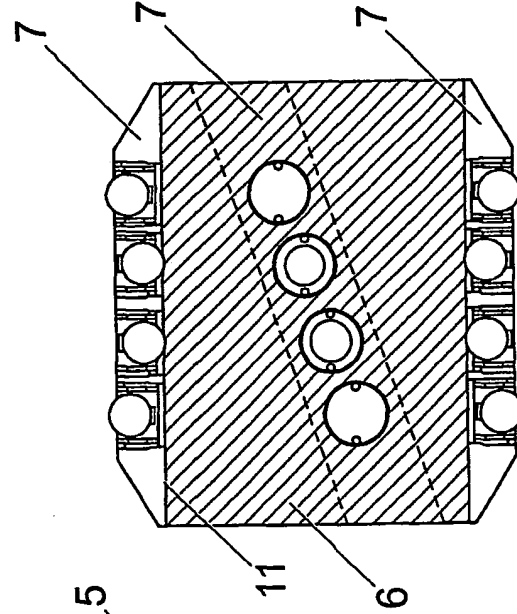


Fig. 2

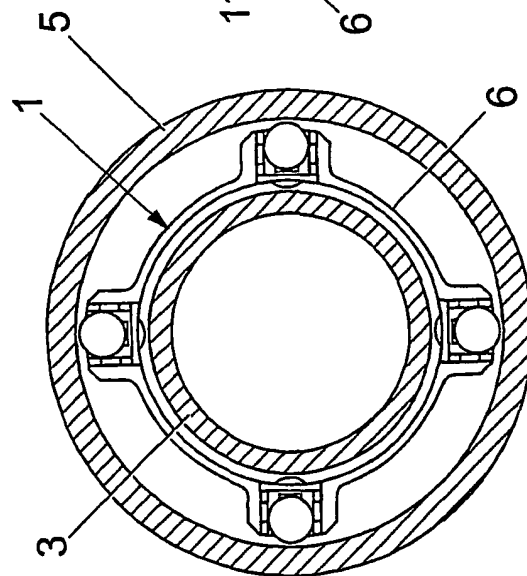


Fig. 1

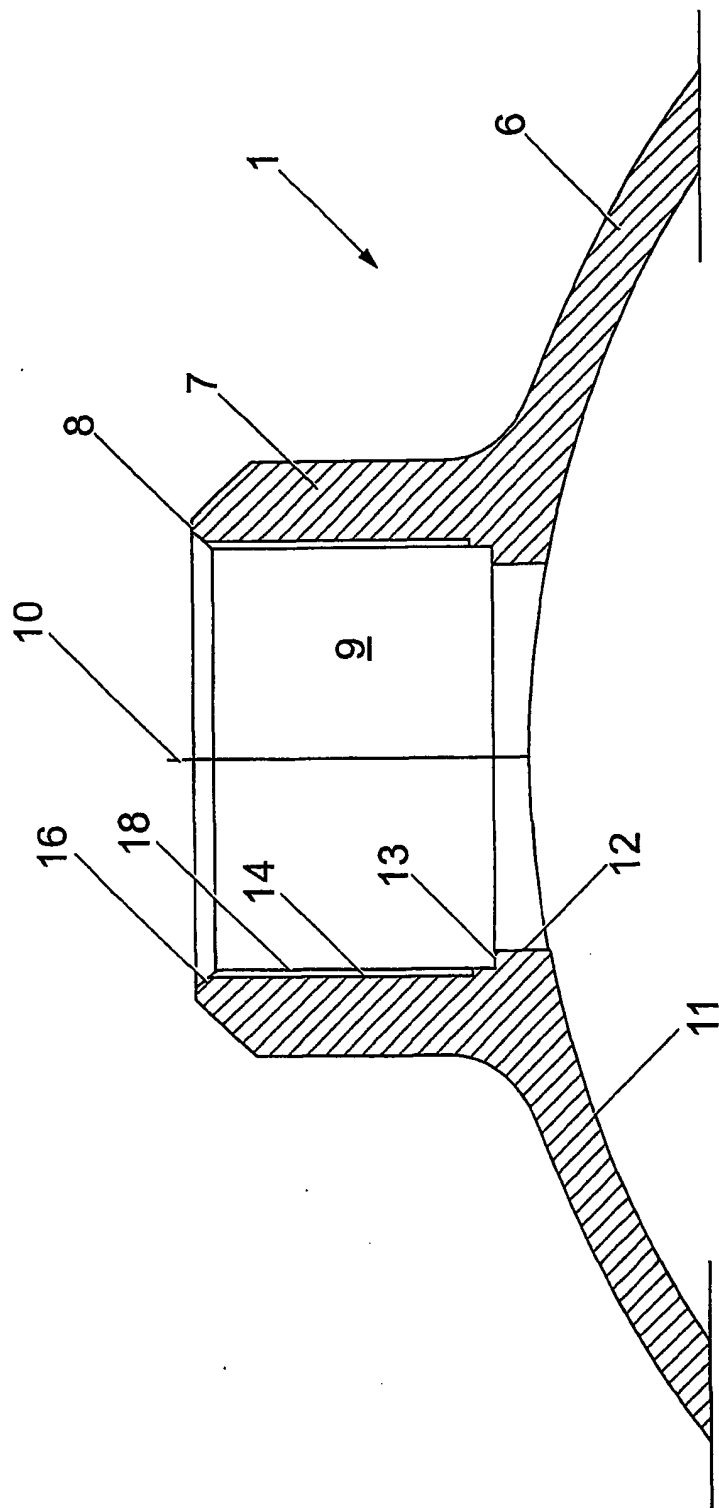


Fig. 4

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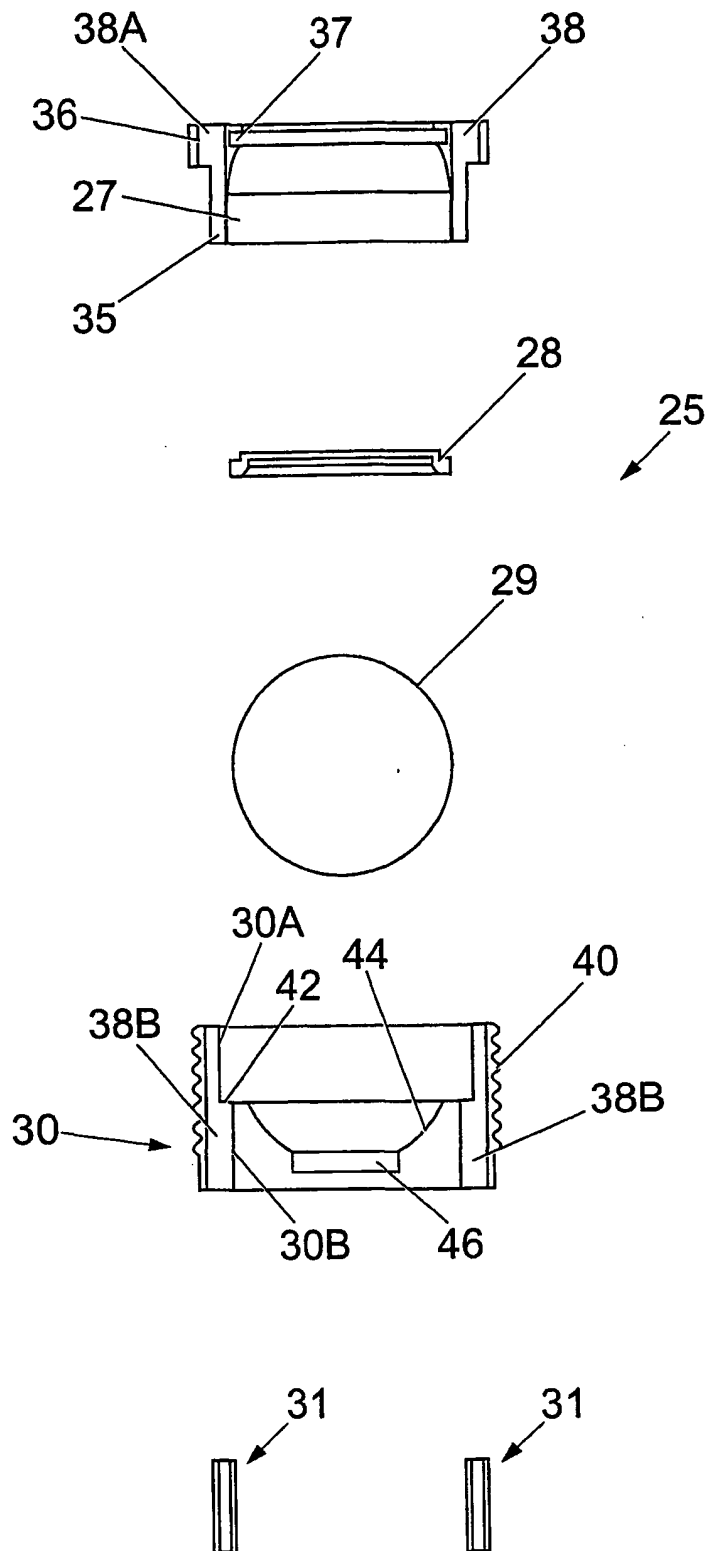


Fig. 5

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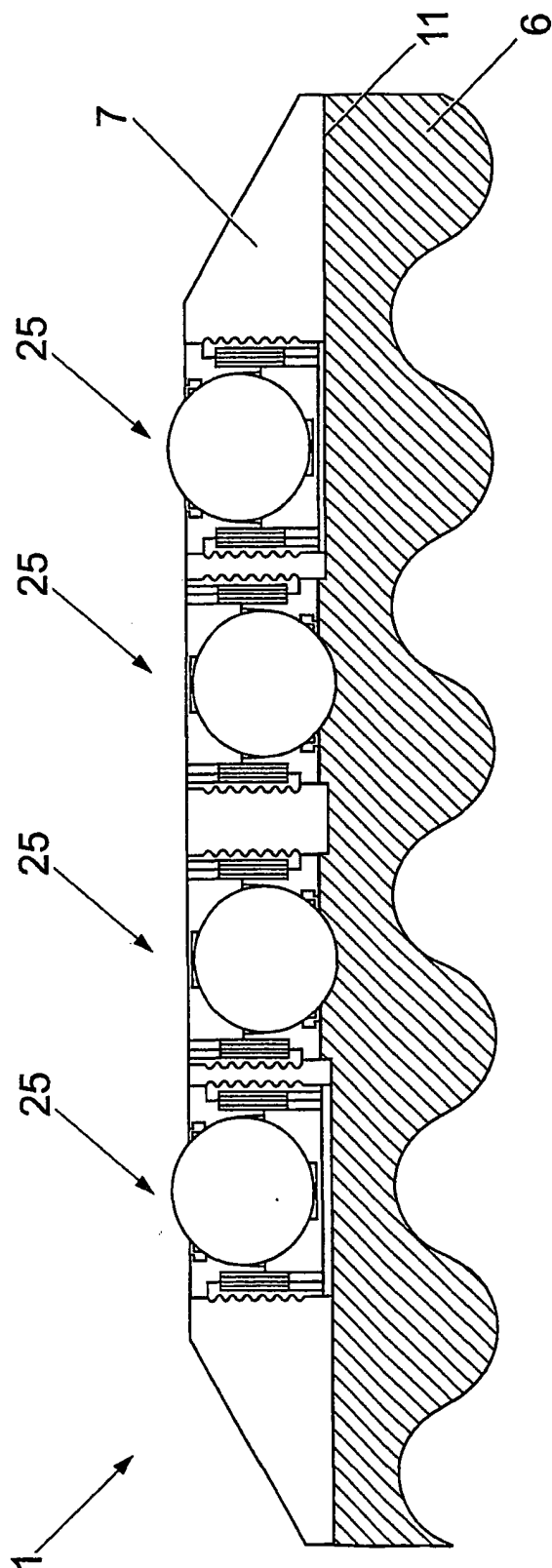


Fig. 6

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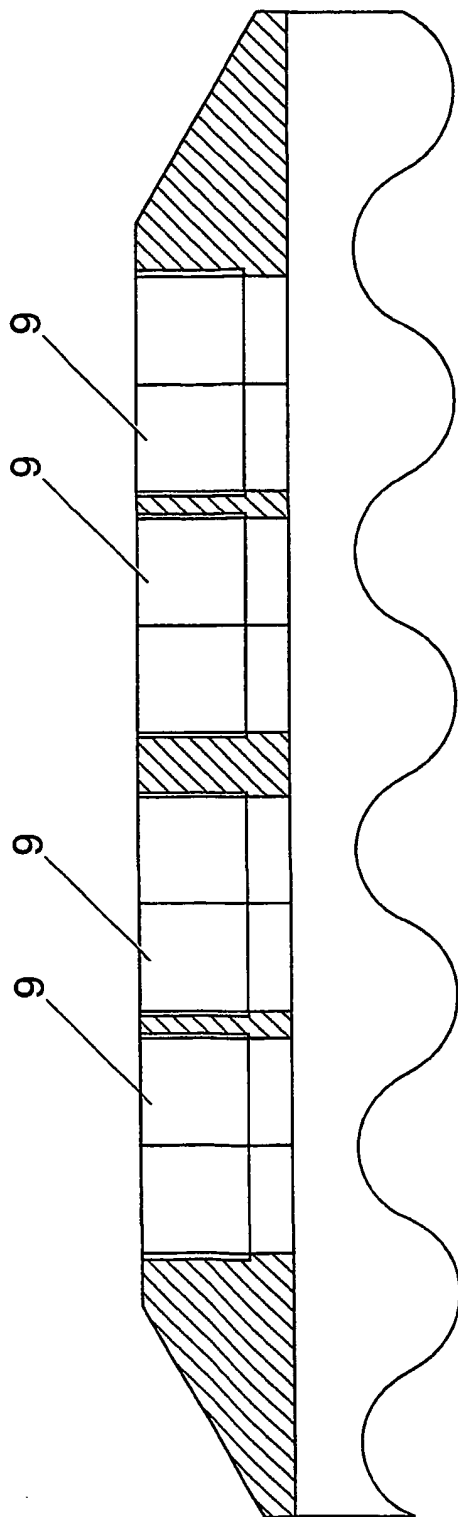


Fig. 7

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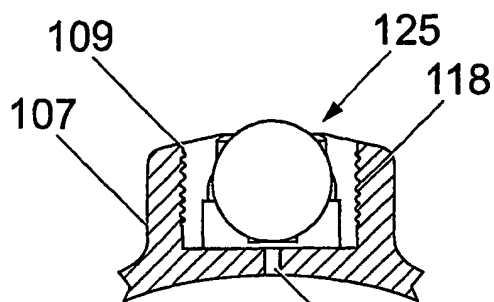


Fig. 8

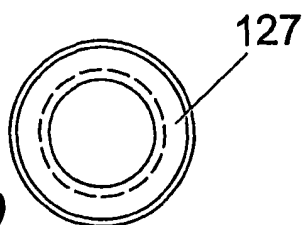


Fig. 10

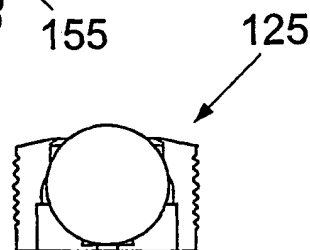


Fig. 9

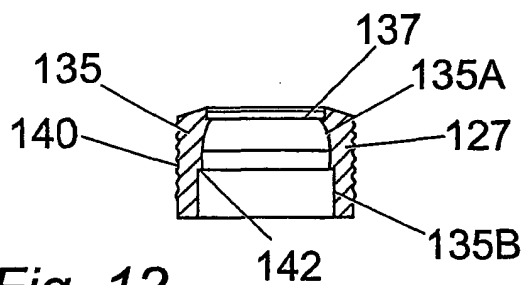


Fig. 12

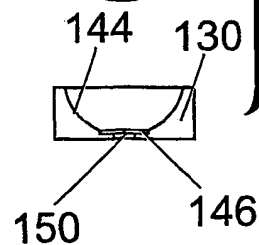
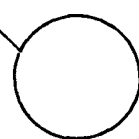
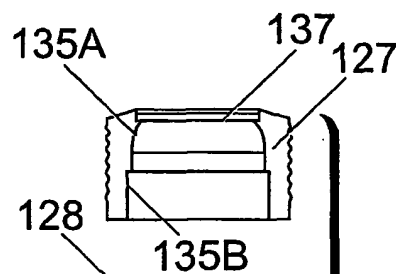


Fig. 11

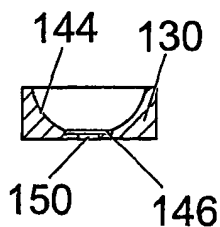


Fig. 13

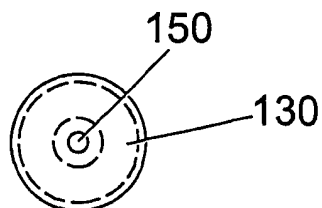


Fig. 14

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E21B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 333 450 A (ABERNETHY ANDERSON CHARLES) 20 September 1989 (1989-09-20) column 1, line 6 - line 8 column 1, line 55 -column 2, line 28; figures 2-4	1-5,7,9, 10,12-18
X	US 1 699 087 A (WOODMANSEE HOLLIS D ET AL) 15 January 1929 (1929-01-15) figure 2	1-4,6-8, 12
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Date of the actual completion of the international search

14 September 2001

Date of mailing of the international search report

24/09/2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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